

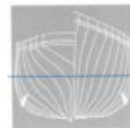
U.S.S. TEXAS (BB-35)

OPTION 6 TANK INSPECTION AND REPAIR ASSESSMENT



Underway replenishment, taking aboard ammunition, 1945.

JOSEPH W. LOMBARDI
OCEAN TECHNICAL SERVICES, LLC.
Marine Surveyor & Consultant
10 Dalton Avenue
Gloucester, Massachusetts 01930



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JOSEPH W. LOMBARDI

Marine Surveyor & Consultant

OCEAN TECHNICAL SERVICES, LLC

10 Dalton Avenue, Gloucester, Massachusetts 01930 Office (978)-526-1894 Fax (866)-381-2687

Vessel Survey Report No. 2461

Vessel surveyed at: La Porte, Texas

Dates of survey: July 2012

Date of Final Report: February 2013

Vessel surveyed: U.S.S. TEXAS (BB-35)

Survey commissioned by: Texas Parks & Wildlife
Battleship TEXAS State Historic Site
3523 Independence Parkway South
La Porte, Texas 77571

Purpose of survey: Option 6 Tank Inspection & Repair Assessment



U.S.S. TEXAS steaming off Mt. Suribachi, Iwo Jima, March 1945.

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EXECUTIVE SUMMARY

This report presents an assessment of the present condition of the tankage contiguous to the exterior shell plating/skin of the vessel as obtained from a thorough and detailed inspection carried out in July 2012. Critical problem areas have been identified as those that merit immediate consideration and repair to be initiated shortly under the Option 6 afloat berthing configuration.

The terms “Option 5” and “Option 6” refer to berthing configurations considered subsequent to Options 1 through 4 considered in the Dry Berth of the Battleship Texas State Historic Site Phase I: Conceptual Design Report (AECOM, September 2011). Option 5 is a berthing configuration that grounds the ship in the dry, directly on the sand within her current berth. Option 6 is an option that includes only selected ship repairs, and the leaves the ship in place in her wet berth with no changes to the berth itself.

It is quite apparent that repairs will be required for the vessel’s shell plating due to issues of thru-skin piping, heavy corrosion of exterior shell plate and outright holed plating; most of these repairs are aft of amidships both port and starboard.

This report covers only the exterior shell plate and tankage; other outboard tankage within the original shell of the ship has already been inspected under Option 5 and this report should be considered a supplement to that report. The extensive blister tank system outboard of the original shell of the ship has not been inspected under this tasking. Option 6 afloat berthing has been chosen (at least for the short/intermediate term) and the end game is that the vessel will be required to float on her own bottom throughout this period. No estimate of scope and cost for repairs can be estimated outside of the inspected areas.

The reporting for this report will commence forward at the port side tanks proceeding aft followed by the starboard side tankage from the forward units proceeding aft. The tankage inspected includes both voids and fuel tanks for the 1st and 2nd Platforms. Inboard tankage contiguous to the exterior shell tankage was not inspected.

A description of repair methodology within each compartment, required remediation within each space, materials required, and estimated costs for repairs are included within the body of this report. A separate estimate of total project costs will be included within the Appendix.

Excluding Option 5 costs; the estimated total cost for repairs within OPTION 6 is \$ 4,449,816.00

Total for Option 5 & Option 6 estimated costs for repairs is \$ 30,352,327.46

Unless these issues outlined within the Option 5 & Option 6 Reports are addressed satisfactorily, there is significant risk in causing serious and irreparable damage to the vessel.

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U.S.S. TEXAS, OPTION 6
TANK INSPECTIONS, 1ST PLATFORM

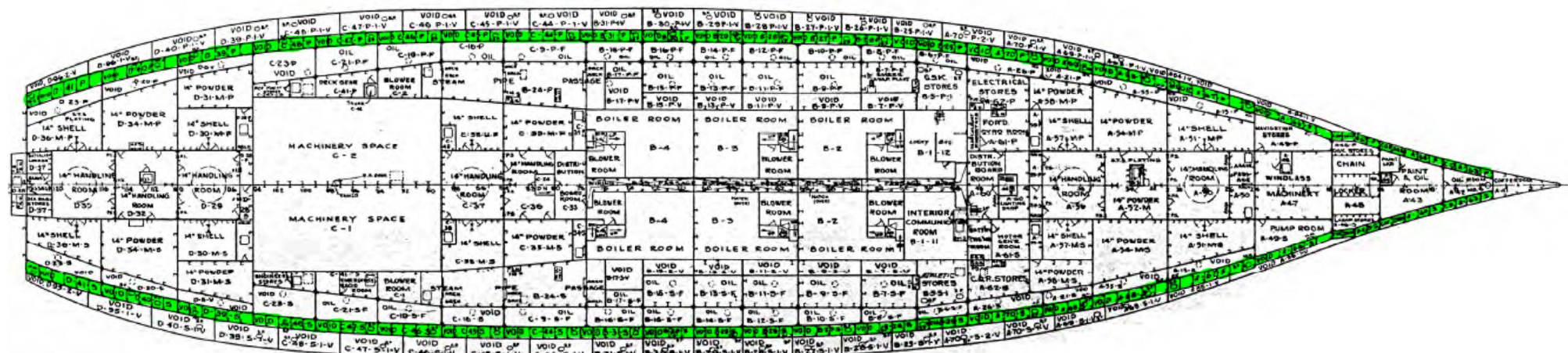


Figure 1. Option 6 Tank Inspections, 1st Platform.

U.S.S. TEXAS, OPTION 6
TANK INSPECTION, 2ND PLATFORM

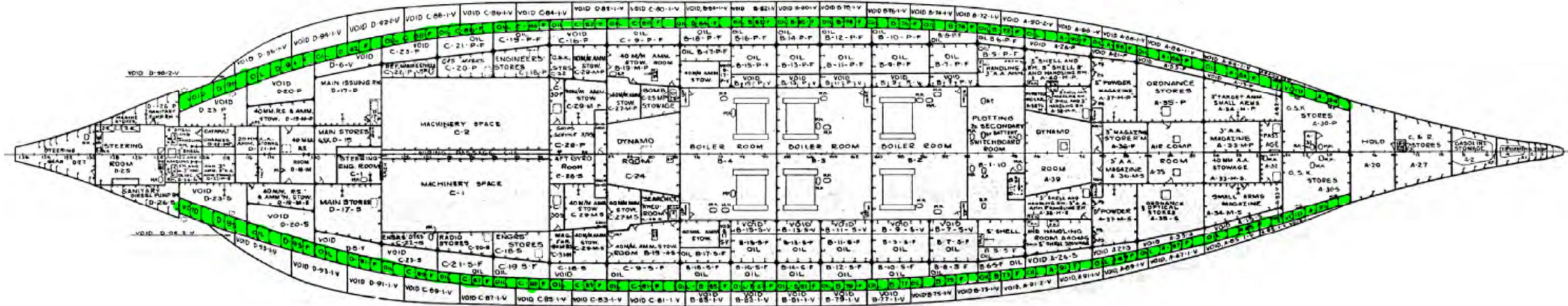


Figure 2. Option 6 Tank Inspections, 2nd Platform.

1. INTRODUCTION

This tank inspection survey of the centerline tankage of the battleship U.S.S. TEXAS was conducted (July 2012) where she lay (aground within the slip bottom; afloat only on high water events) at the San Jacinto State Battleground Park within her side slip/berth in the Houston Ship Channel.

The purpose of this tank inspection was to ascertain the scope and estimated costs for repairs needed for the vessel under Option 6 scenarios.

The surveyor was tasked with identifying issues of structure, internal tankage and the present/future issues facing the ship from a material condition perspective. The surveyor was also tasked with recommending general alterations or improvements needed within this tankage to properly support the continued afloat capability of this vessel.

Inspections of the outboard blister tank appendages were not a part of this survey.

The ship's staff assisted greatly in this task of opening tank covers and hatches where they could safely enter spaces. Spaces not inspected are not noted within this report. Entry into fuel and/or ballast tanks was subject to air quality requirements under 29 CFR Code of Federal Regulation requirements and this was done with inspections carried out by a certified Marine Chemist. Where tank inspections were not possible, visual inspections from tank manhole covers was accomplished with photographs being taken by ISHOT 550 HD camera. The underwater appendage was not observed.

The inspection of this vessel started from forward to aft, and top to bottom for both port and starboard tankage and shall be described following that same course here in the narrative. Comments, observations and recommendations from the surveyor are in highlighted **bold** format. Observations and corresponding recommendations for dangerous and critical conditions are made in highlighted **bold and red font** format.

The Code of Federal Regulations (CFR), American Boat & Yacht Council (ABYC), International Marine Organization (IMO), National Fire Protection Association (NFPA), and the Society of Naval Architects and Marine Engineers (SNAME) are utilized in compiling this report. Individual reference to subchapters of the above is not made within the body of this report. Other sources include the 'U.S. Navy Towing Manual', 'Manual on Ship Construction', George C. Manning: Van Nostrand Co., and 'Standards For Steel Hulled Vessels', American Bureau of Shipping, 'Stability and Trim for the Ship's Officer' by William E. George, Cornell Maritime Press and 'Ship Design and Construction' by the Society of Naval Architects and Marine Engineers.

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2. PORT SIDE TANK INSPECTIONS

2.1 A-63P, Frames 4 – 9

Space is mildly corroded with intact paint system on the upper tank and mild corrosion of shell plating and scantlings as one proceeds to tank bottom. No standing water. This space requires no structural repairs or modifications.



Figure 3. Tank A-63P.

2.2 A-64P, Frames 9 – 14

Space is mildly corroded with intact paint system on the upper tank and mild corrosion of shell plating and scantlings as one proceeds to tank bottom. No standing water. This space requires no structural repairs or modifications.



Figure 4. Tank A-64P.

2.3 A-65P, Frames 14 – 18

Space is mildly corroded with intact paint system on the upper tank and mild corrosion of shell plating and scantlings as one proceeds to tank bottom. No standing water. This space requires no structural repairs or modifications.



Figure 5. Tank A-65P.

2.4 A-66P, Frames 18 – 24

Space is moderately corroded, but not structurally deficient. Side shell and scantling degraded 10 – 15%, floors 20 -30%. No standing water. Peeling paint and rust/scale abound. This space requires no structural repairs or modifications.



Figure 6. Tank A-66P.

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2.5 A-94V, Frames 18 – 24

Space is moderately corroded, but not structurally deficient. Upper tank side shell and scantling degraded 20%, floors 20 -30%. Lower tank side shell and scantlings degraded 20 – 30%, floors degraded 40%. No standing water. Peeling paint and much rust/scale abound. This space requires no structural repairs or modifications.

2.6 A-67P, Frames 24 – 31

Space is mildly corroded, but not structurally deficient. Side shell and scantling degraded 10 – 15%, floors 20 -30%. No standing water. Peeling paint and rust/scale abound. This space requires no structural repairs or modifications.



Figure 7. A-67P.

2.7 A-84F, Frames 24 – 31

Space is moderately corroded, but not structurally deficient. Side shell and scantling degraded 20 – 25%, floors 30 -40%. No standing water. Peeling paint and rust/scale abound. This space requires no structural repairs or modifications.

Oil seepage from riveted plate lap seams on inside bulkhead throughout compartment.

2.8 A-68P, Frames 31 – 37

Space is moderately corroded, but not structurally deficient. Side shell and scantling degraded 10 – 15%, floors 20 -30%. 6 – 8” standing water. Peeling paint and rust/scale abound. This space requires no structural repairs or modifications.

2.8 A-68P, Frames 31 – 37 (cont.)



Figure 8. A-68P.

2.9 A-86F, Frames 31 – 37

Space is moderately corroded, but not structurally deficient. Upper tank side shell and scantling degraded 10% with intact coatings, floors 10-20%. Lower tank side shell and scantlings degraded 30 – 50%, floors degraded 40%. No standing water. Peeling paint and much rust/scale abound. This space requires no structural repairs or modifications.

2.10 A-69P, Frames 37 – 41

Space is moderately corroded, but not structurally deficient. Side shell and scantling degraded 15 – 30%, floors 30-40%. No standing water. Peeling paint and rust/scale abound. This space requires no structural repairs or modifications.

2.11 A-88F, Frames 37 – 41

Space is moderately corroded, but not structurally deficient. Upper tank side shell and scantling degraded 20%, floors 20-30%. Lower tank side shell and scantlings degraded 30 – 40%, floors degraded 50%. No standing water; but oil residue abounds. Peeling paint and much rust/scale abound. This space requires no structural repairs or modifications but should be monitored for future problems..

2.12 A-70P, Frames 41 – 47

Space is moderately corroded, but not structurally deficient. Side shell and scantling degraded 30 – 30%, floors 30-40%. No standing water. Peeling paint and rust/scale abound. This space requires no structural repairs or modifications.

Oil seepage from riveted plate lap seams on inboard bulkhead throughout compartment. Check inboard tank A-26P for oil contamination

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2.13 A-90F, Frames 41 – 47

Space is moderately corroded, but not structurally deficient. Upper tank side shell and scantling degraded 20%, floors 20 -30%. Intermediate flat shows side shell and scantlings degraded 20%. Lower tank side shell and scantlings degraded 30 – 40%, floors degraded 50%. No standing water; but oil residue abounds on upper portion of tank. Peeling paint and much rust/scale abound. This space requires no structural repairs or modifications.

2.14 B-25P, Frames 47 – 51

Space is moderately corroded, but not structurally deficient. Side shell and scantling degraded 10 – 15%, floors 30 -40%. No standing water. Peeling paint and rust/scale abound. This space requires no structural repairs or modifications.



Figure 9. Side shell of B-25P showing armor hanging bolts.

2.15 B-72F, Frames 47 – 51

Space is moderately corroded, but not structurally deficient. Upper tank side shell and scantling degraded 10 – 15%, floors 20%. Intermediate side shell and scantlings degraded 20%. Lower tank side shell and scantlings degraded 20 %, floors degraded 20%. Standing 3' of water at bottom of tank. **Two (2) 4" piping through skin of ship will need to be removed with doubler plate installed over skin** Peeling paint and much rust/scale abound.

Verify that blister tankage outboard is dry, remove piping and weld two 12" x 12" $\frac{3}{4}$ " A-36 mild steel doubler plate over holes in side shell.

2.15 B-72F, Frames 47 – 51 (cont.)



Figure 10. Through-hull piping in lower flat of B-72F to blister tankage.

2.16 B-26F, Frames 51 – 57

Not observed.

2.17 B-74F, Frames 51 – 57

Not observed.

2.18 B-27P, Frames 57 – 61

Space is moderately corroded, but not structurally deficient. Side shell and scantling degraded 10 – 20%, floors 30 -40%. 1” standing water. Slight seepage from armor hanging bolts and plate lap joints. Peeling paint and rust/scale abound. This space requires no structural repairs or modifications.



Figure 11. Floor of B-27P showing wetness/seepage of water from armor hanging bolt.

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2.19 B-76F, Frames 56 ½ - 60 ½

Space is moderately corroded, but not structurally deficient. Upper tank side shell and scantling degraded 20 – 30%, floors 30%. Intermediate side shell and scantlings degraded 20 – 30% with oil seepage from behind riveted plate lap seams. **Lower tank side shell and scantlings degraded 40 % with 8' of standing water at bottom of tank.** Peeling paint and much rust/scale abound.

Dewater tank, inspect and renew with ¾" A-36 mild steel doubler plating as needed. Estimate 400 sq. ft.



Figure 12. Standing water in B-76F at turn of bilges.

2.20 B-28P, Frames 61 – 65

Space is mildly corroded with intact paint system on the upper tank and mild corrosion of shell plating and scantlings as one proceeds to tank bottom. No standing water. This space requires no structural repairs or modifications.



Figure 13. B-28P in good material condition.

2.21 B-78F, Frames 60 ½ - 65

Space is moderately corroded, but not structurally deficient. Upper tank side shell and scantling degraded 20 – 30%, floors 30%. Upper shell plating dished in 3" throughout space; appears to be a very old condition. **Intermediate side shell and scantlings degraded 20 – 30% with a 2" pipe into blister tankage through side shell plating. Bottom scantlings, shell plating degraded 25 – 30% with a 6" pipe through side shell into blister tankage.** Peeling paint and much rust/scale abound. No standing water.



Figure 14. Dished in shell plating on right side of photo in B-76F on upper flat.

Verify that blister tankage outboard is dry, remove piping and weld two (2) 12" x 12" ¾" A-36 mild steel doubler plates over holes in side shell.

2.22 B-29P, Frames 65 – 69

Space is moderately corroded, but not structurally deficient. Side shell and scantling degraded 10 – 20%, floors 30 -40%. ½" standing water. Slight seepage from armor hanging bolts and plate lap joints. Peeling paint and rust/scale abound. This space requires no structural repairs or modifications.



Figure 15. Bottom plating in B-29P.

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2.23 B-80F, Frames 65 – 69

Space is moderately corroded, but not structurally deficient. Upper tank side shell and scantling degraded 20 – 30%, floors 30%. Upper shell plating dished in 3" throughout space; appears to be a very old condition. **Intermediate side shell and scantlings degraded 50%+ with oozing water behind heavy rust through side shell plating. Bottom scantlings, shell plating buckled with wetness behind heavy rust in various areas degraded 30 – 50% through side shell into blister tankage..** Peeling paint and much rust/scale abound. 2' standing water.



Figure 16. Side shell plating in intermediate flat of B-80F showing wasted armor hanging bolt & wetness through side shell plating.

Properly prepare surfaces of shell plating, install approximately 420 square feet of 3/4" A-36 doubler plate over affected area.

2.24 B-30P, Frames 69 – 73

Space is moderately corroded, but not structurally deficient. Much mold throughout space indicating previous wetness and poor ventilation. Side shell and scantling degraded 30 – 40%, floors 30 -40%. No standing water. Peeling paint and rust/scale abound. This space requires no structural repairs or modifications.



Figure 17. Lower portion of tank showing flooring in B-30P.

2.25 B-82F, Frames 69 – 73

Space is moderately corroded, but not structurally deficient. Upper tank side shell and scantling degraded 20 – 30%, floors 30% with minor seepage of oil from riveted plate lap seams throughout. **Intermediate side shell and scantlings degraded 30 – 40% with a single 4" pipe and a single 2" pipe into blister tankage through side shell plating.** Bottom scantlings, shell plating degraded 25 – 30% with minor seepage of oil from riveted plate lap seams throughout. Peeling paint and much rust/scale abound. 1 -2" of standing water/oil in bilges.

Verify that blister tankage outboard is dry, remove piping and weld two (2) 12" x 12" $\frac{3}{4}$ " A-36 mild steel doubler plate over holes in side shell.



Figure 18. 4" pipe through side shell plating on intermediate flat of B-82F.



Figure 19. Standing oil/water in tank bottom B-82F.

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2.26 B-31P, Frames 73 – 77

Space is moderately corroded, but not structurally deficient. Side shell and scantling degraded 20 – 30%, floors 30 -40%. No standing water. Slight seepage of oil from riveted lap seams. Peeling paint and rust/scale abound. This space requires no structural repairs or modifications.



Figure 20. Side shell plating showing armor hanging bolts in B-31P.

2.27 B-84F, Frames 73 – 77

Space is moderately corroded and structurally deficient. **Upper tank side shell and scantling degraded 50 – 70%**, floors 30% with minor seepage of oil from riveted plate lap seams throughout. A 2” pipe is through to the blister tank from the upper flat. An 8’ x 12’ and a 14’ x 30’ section of shell plating is weeping water from the blister tankage.

Intermediate side shell and scantlings degraded 50 – 70% with weeping rivets throughout; a single 4” pipe is fitted into blister tankage through side shell plating. Bottom scantlings, shell plating degraded 25 – 40% with minor seepage of oil from riveted plate lap seams throughout; a 5” pipe extends through shell plating into blister tankage. Peeling paint and much rust/scale abound. 6” of standing water/oil in bilges. Framing buckled, but not in danger of tripping throughout bottom of tank space.

Ensure adjacent blister tankage is dry. Properly prepare shell plating and install approximately 550 square feet of 3/4” A-36 mild steel doubler plating.

Ensure adjacent blister tankage is dry. Properly prepare shell plating and install three (3) 12" x 12" of 3/4" A-36 mild steel doubler plating over piping holes.

2.27 B-84F, Frames 73 – 77 (cont.)



Figure 21. Piping going through side shell in B-84F.



Figure 22. Piping going through side shell in B-84F

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2.28 C-44P, Frames 78 - 84

Space is mildly corroded with intact coatings, but not structurally deficient. Side shell and scantling degraded 10%, floors 20%. 1" standing water/oil. Slight seepage of oil from riveted lap seams. This space requires no structural repairs or modifications.



Figure 23. Tank C-44P.

2.29 C-80F, Frames 78 – 84

Space is moderately corroded, but not structurally deficient. Upper tank side shell and scantling degraded 20%, floors 30%. Intermediate side shell and scantlings degraded 30 – 40% with oil seepage from behind riveted plate lap seams. Bottom scantlings and shell plating show 30 – 40% degradation with 3" of standing water/oil at bottom of tank. Peeling paint and much rust/scale abound.



Figure 24. Tank C-80F showing standing oil/water on bottom.

2.30 C-45P, Frames 84 – 89

Space is mildly corroded with intact coatings, not structurally deficient. Side shell and scantling degraded 10%, floors 20%. No standing water/oil. Slight seepage of oil from riveted lap seams on inboard and outboard shell. This space requires no structural repairs or modifications.



Figure 25. View of interior of C-45P.

2.31 C-82F, Frames 84 – 89

Space is moderately corroded, but not structurally deficient. Upper tank side shell and scantling degraded 20%, floors 30%. Intermediate side shell and scantlings degraded 20 – 30% with water seepage from behind riveted plate in an 8' x 20' section to be repaired by ring welding rivets. Bottom scantlings and shell plating show 30 – 40% degradation weeping rivets in a 7' x 20' section with 4" of standing water/oil at bottom of tank. Peeling paint and much rust/scale abound.

Ensure adjacent blister tankage is dry. Properly prepare shell plating and install approximately 300 square feet of $\frac{3}{4}$ " A-36 mild steel doubler plating.



Figure 26. Intermediate flat showing weeping rivets in C-82F.

[Type text]

2.31 C-82F, Frames 84 – 89 (cont.)



Figure 27. Bottom standing water/oil in C-82F.

2.32 C-46P, Frames 89 – 94

Flooded space at time of survey. Not inspected.

2.33 C-84F, Frames 89 – 94

Flooded space at time of survey. Not inspected.

2.34 C-47P, Frames 94 – 99

Flooded space at time of survey. Not inspected.

2.35 C-86F, Frames 94 – 99

Flooded space at time of survey. Not inspected.

2.36 C-48P, Frames 99 – 104

Space is mildly corroded with intact coatings, not structurally deficient. Side shell and scantling degraded 10%, floors 20%. No standing water/oil. Slight seepage of oil from riveted lap seams on inboard and outboard shell. This space requires no structural repairs or modifications.



Figure 28. Interior of C-48P.

2.37 C-88F, Frames 99 – 104

This tank is flooded almost to the top. A 4" pipe is through the side shell into the blister on the upper flat. Water is leaking through the side shell plating in many areas; this tank needs to be de-watered and patched. The exterior blister tank will also need to be repaired/patched before any repairs can be accomplished. Estimate 8' x 30' section of shell plating to be doubled/repaired.

Properly prepare shell plating and weld approximately 240 square feet of $\frac{3}{4}$ " A-36 mild steel plate to



Figure 29. Interior of upper flat to C-88F showing leaking shell plating.

2.38 D-39P, Frames 104 – 110

Space is mildly corroded at top with intact coatings; lower compartment has wasted framing. Side shell degraded 20%, floors 30 – 40%, flanges totally wasted. Replace bases of two(4) $\frac{3}{8}$ " vertical flanges on

[Type text]

bottom frames. 3 – 4” standing water/oil. Slight seepage of oil from riveted lap seams on inboard and outboard shell.



Figure 30. View of aft end of D-39P.



Figure 31. Detail of wasted flange in D-39P

2.39 D-92F, Frames 104 -110

Space is moderately corroded, but not structurally deficient. Upper tank side shell and scantling degraded 20%, floors 30%. Lower flat shows side shell and scantlings degraded 30 – 50% with oil seepage from behind

riveted plate lap seams. Bottom scantlings and shell plating show 30 – 40% degradation in lower flat; no standing water/oil at bottom of tank. Peeling paint and much rust/scale abound.



Figure 32. Upper flat of D-92F.



Figure 33. Lower flats of D-32F.

2.40 D-40P, Frames 110 – 116

[Type text]

Space is mildly corroded at top with intact coatings; lower compartment has wasted framing. Side shell degraded 20%, floors 30 – 40%, flanges totally wasted. Replace bases of two (2) 3/8" vertical flanges on bottom frames. 4 – 6" standing water/oil. Slight seepage of oil from riveted lap seams on inboard shell.



Figure 34. Lower portion of D-40P showing vertical scantlings.



Figure 35. Bottom of tank in D-40P showing standing water/oil.

2.41 D-91F, Frames 110 -116

This tank has had recent plugged holes to the exterior blister tankage. Shell plating in the upper portion of tank is degraded 25 – 35%. Lower exterior shell plating wasted 50 -80% throughout most of the bottom of the tank; much recent moisture. Repair 8' x 24' section of exterior plating with $\frac{3}{4}$ " A-36 doubler plate Standing water 3-5".

Ensure adjacent blister tankage is dry. Properly prepare shell plating and install approximately 200 square feet of $\frac{3}{4}$ " A-36 mild steel doubler plating.



Figure 36. Lower flat of D-91F.



Figure 37. Wasted plating below armor hanging bolt in D-91F.

2.42 D-41P, Frames 116 – 122

[Type text]

Space is badly corroded at top with intact coatings; lower compartment has badly wasted framing and shell plating. **Bottom side shell degraded 80%+ and shows evidence that it will shortly be breached.** Sheath 20' x 25' section of doubler shell plating with $\frac{3}{4}$ " A-36 mild steel plate.; replace 5' x 20' section of shell plating with $\frac{3}{4}$ " A-36 mild steel plate. Floors 30 – 40%, flanges totally wasted.

Replace bases of four (4) $\frac{3}{8}$ " x 10" channel stock on the bottom 2' of vertical stanchions. 4 – 6" standing water/oil.

Ensure adjacent blister tankage is dry. Properly prepare shell plating and install approximately 600 square feet of $\frac{3}{4}$ " A-36 mild steel doubler plating.



Figure 38. Wasted lower section of vertical stanchion in D-41P.



Figure 39. Wasted shell plating within D-41P.

2.43 D-90V, Frames 116 – 122

Tank flooded; not inspected at time of survey.

Ensure adjacent blister tankage is dry. Properly prepare shell plating and install estimated 400 square feet of $\frac{3}{4}$ " A-36 mild steel doubler plating.



Figure 40. Detail of flooded D-90V.



Figure 41. Flooded upper portion of D-90V.

2.4.4. Naval Architect's Comment on Repairs to Port Tankage

2.4.4.1. The shell plating represents the main line of defense of the battleship against water intrusion. Returning the plating to its original watertight condition and elimination of all piping penetrations between the blister tankage and the original shell are considered the primary repairs at this time.

2.4.4.2. Repair of the plating by doubler plates rather than the more cosmetic "cut and replace" are believed to ensure that the repairs are as watertight as possible. Likewise removal of pipe penetrations and reinforcement with a doubler plate will minimize the chances of any liquids in the blister tanks finding a way into the main hull of the battleship.

2.4.4.3. Restoration of the watertight integrity of the main hull plating, along with a maintenance plan to ensure the paint and cathodic protection remain effective, will significantly extend the useful life of the hull of the battleship.

3. STARBOARD SIDE TANK INSPECTIONS

[Type text]

3.1 A-63S, Frames 4 -9

Space is moderately corroded, but not structurally deficient at this point. Upper tank side shell and scantling degraded 30 – 40%, floors 40 – 50%. Lower flat shows side shell and scantlings degraded 50 – 70% with piles of rust (some 10” high). Rivets show wastage of 40%, but no seepage or leaks.. Bottom scantlings and shell plating show 40 – 70% degradation in lower flat; no standing water/oil at bottom of tank. Peeling paint and much rust/scale abound.



Figure 42. Corroded scantlings in A-63S.

3.2 A-64S, Frames 9 -14

Space is moderately corroded, but not structurally deficient at this point. Upper tank side shell and scantling degraded 30 – 40%, floors 30 – 40%. Lower flat shows side shell and scantlings degraded 40 – 70% with piles of rust (some 10" high). Rivets show wastage of 20 – 30%, but no seepage or leaks. Bottom scantlings and shell plating show 40 – 50% degradation in lower flat; no standing water/oil at bottom of tank. Peeling paint and much rust/scale abound.



Figure 43. Corroded scantlings in A-64S.

3.3 A-65S, Frames 14 – 18

[Type text]

Space is moderately corroded, but not structurally deficient at this point. Upper tank side shell and scantling degraded 20 – 30%, floors 20 – 0%. Lower flat shows side shell and scantlings degraded 25 – 30%. Rivets show wastage of less than 20%, no seepage or leaks. Bottom scantlings and shell plating show 40 – 50% degradation in lower flat; no standing water/oil at bottom of tank. Peeling paint and much rust/scale abound.



Figure 44. Upper flat of A-65S.



Figure 45. Intermediate flat of A-65S.

3.4 A-66S, Frames 18 – 24

Space is mildly corroded with partially intact paint system on the upper tank and mild/moderate corrosion (25 – 35%) of shell plating and scantlings as one proceeds to tank bottom. No standing water. This space requires no structural repairs or modifications.

3.5 A-95V, Frames 18 – 24

Space is moderately corroded, but not structurally deficient. Upper tank side shell and scantling degraded 20%, floors 20 -30%. Lower tank side shell and scantlings degraded 20 – 30%, floors degraded 40%. Rivets degraded 25 – 30%. Peeling paint and much rust/scale abound. No standing water. This space requires no structural repairs or modifications.

3.6 A-67S, Frames 24 – 31

Space is moderately corroded, but not structurally deficient. Upper tank side shell and scantling degraded 20%, floors 20 -30%. Lower tank side shell and scantlings degraded 40 – 50%, floors degraded 40%. Rivets degraded 25 – 30%. Peeling paint and much rust/scale abound. No standing water. This space requires no structural repairs or modifications.

3.7 A-85F, Frames 24 – 31

Not inspected at time of survey. Space was flooded at time of survey. Leakage could be heard emanating from blister tankage.

Ensure adjacent blister tankage is dry. Properly prepare shell plating and install estimated 400 square feet of 3/4" A-36 mild steel doubler plating.

3.8 A-68S, Frames 31 – 37

Space is moderately corroded, but not structurally deficient. Upper tank side shell and scantling degraded 20%, floors 20 -30%. Lower tank side shell and scantlings degraded 40 – 50%, floors degraded 40%. Rivets degraded 25 – 30%. Peeling paint and much rust/scale abound. No standing water. This space requires no structural repairs or modifications.

3.9 A-87F, Frames 31 – 37

Space is moderately corroded, but not structurally deficient. Upper tank side shell and scantling degraded 25%, floors 20 -30%. Lower tank side shell and scantlings degraded 30 – 40%, floors degraded 40%. Rivets degraded 20 – 25%. Peeling paint and much rust/scale abound. 6 – 8" standing water. This space requires no structural repairs or modifications.

3.10 A-69S, Frames 37 – 41

Space is mild/moderately corroded, and mildly structurally deficient. Upper tank side shell and scantling degraded 20%. Lower tank side shell and scantlings degraded 25 – 30%, floors degraded 40 – 60%. Rivets degraded 20 – 30%. Oil emanating from outboard riveted seams throughout tank. Peeling paint and much rust/scale abound. 3- 5" standing water.

Hole in forward tank bulkhead. Crop out wasted steel and insert 12" x 24" 1/2" A-36 mild steel plate.

3.10 A-69S, Frames 37 – 41 (cont.)

[Type text]



Figure 46. Forward end of A-69S.

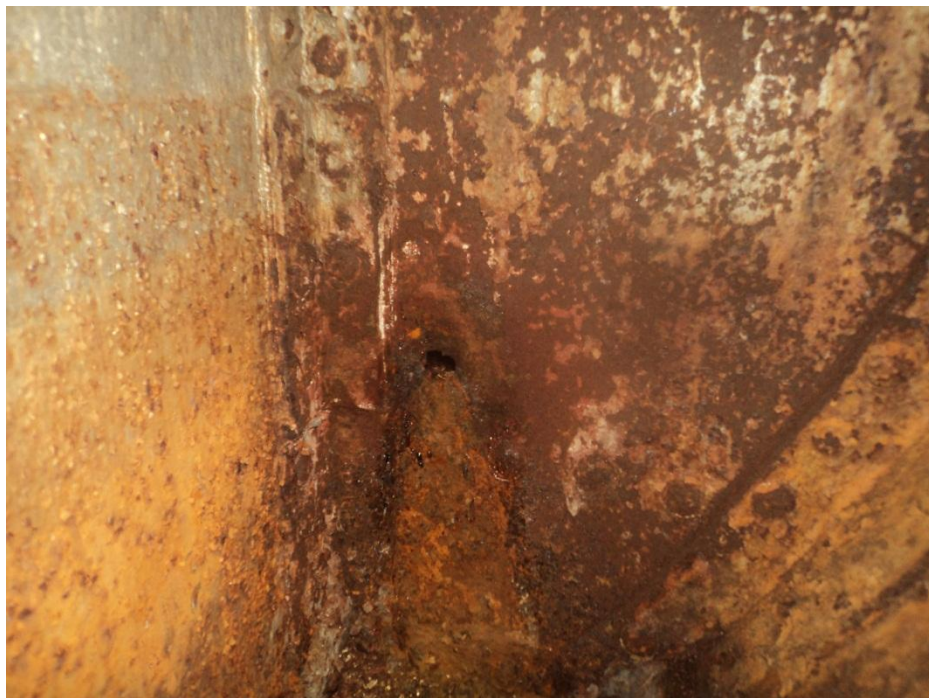


Figure 47. Holed plating on forward bulkhead of A-69S.

3.11 A-89F, Frames 37 – 41

Space is moderately corroded, but not structurally deficient. Upper tank side shell and scantling degraded 25%, floors 20 -30%. Lower tank side shell and scantlings degraded 30 – 40%, floors degraded 40%. Rivets degraded 20 – 25%. Peeling paint and much rust/scale abound. No standing water. This space requires no structural repairs or modifications.



Figure 48. Intermediate flat of A-89F.

3.12 A-70S, Frames 41 – 47

Space is moderately corroded, and mildly structurally deficient. Upper tank side shell and scantling degraded 20%. Lower tank side shell and scantlings degraded 25 – 30%, floors degraded > 40 – 60%. Rivets degraded 20 – 30%. Peeling paint and much rust/scale abound. **3- 4' standing water with 6" of muck beneath.**



Figure 49. Standing water in A-70S.

3.13 A-91F, Frames 41 – 47

[Type text]

Space is mildly/moderately corroded, but not structurally deficient. Much mold throughout space. Upper tank side shell and scantling degraded 10%, floors 20 -30%. Lower tank side shell and scantlings degraded 30 – 50%, floors degraded 40%. Rivets degraded 20 – 25% in lower flats. Peeling paint and much rust/scale abound. No standing water. This space requires no structural repairs or modifications.



Figure 50. Upper flat of A-91F.



Figure 51. Intermediate flat of A-91F.

3.14 B-25S, Frames 47 – 51

Space is mildly corroded with partially intact paint system on the upper tank and mild/moderate corrosion (25 – 35%) of shell plating and scantlings as one proceeds to tank bottom. No standing water. This space requires no structural repairs or modifications.



Figure 52. General good condition of B-25S.

3.15 B-73F, Frames 47 – 51

Space is moderately corroded, but not structurally deficient. Upper tank side shell and scantling degraded 25%, floors 20 -30%. Lower tank side shell and scantlings degraded 30 – 40%, floors degraded 40%. Rivets degraded 20 – 25%. Peeling paint and much rust/scale abound. **3' standing water/oil.** This space requires no structural repairs or modifications.



Figure 53. Shell plating at turn of the bilge in B-73F.

3.16 B-26S, Frames 51 – 56

[Type text]

Not inspected at time of survey.

3.17 B-75F, Frames 51 – 56

Not inspected at time of survey.

3.1.8 B-27S, Frames 56 – 61

Space is mildly corroded with partially intact paint system on the upper tank and mild/moderate corrosion (25 – 35%) of shell plating and scantlings as one proceeds to tank bottom. Moldy throughout space. Minor seepage of oil from riveted seams in corners. No standing water. This space requires no structural repairs or modifications.



Figure 54. Interior of B-27S, looking aft.

3.1.9 B-77F, Frames 56 – 61

Space is moderately corroded. Upper tank side shell and scantling degraded 25%, floors 20 -30%. Lower tank side shell and scantlings degraded 30 – 40%, floors degraded 40%. Rivets degraded 20 – 25%. Peeling paint and much rust/scale abound. Moldy throughout space. Minor seepage of oil from riveted seams in corners. **3' standing water/oil. Leaking shell plating on bottom of tank.** Bottom longitudinals badly wasted(>60% wastage), but are not considered a structural problem at this time.

Ensure dewatered blister tankage outboard and insert 12" x 24" 3/4" A-36 mild steel doubler patch on lower side shell plating.



Figure 55. Leaking shell plating from blister tankage in B-77F

3.1.9 B-77F, Frames 56 – 61 (cont.)



Figure 56. Standing water/oil and deteriorated structure in B-77F.

3.2.0 B-28S, Frames 61 - 65

Space is mildly corroded with partially intact paint system on the upper tank and mild/moderate corrosion (15 – 20%) of shell plating and scantlings as one proceeds to tank bottom. No standing water. This space requires no structural repairs or modifications.



Figure 57. Interior of B-28S.

3.2.1 B-79F, Frames 61 – 65

[Type text]

Space is moderately corroded, but not structurally deficient. Upper tank side shell and scantling degraded 25%, floors 20 -30%. One (1) 3" pipes extend through outer shell plating on upper flat. Lower tank side shell and scantlings degraded 30 – 40%, floors degraded 40%. Rivets degraded 20 – 25%. Peeling paint and much rust/scale abound. Minor seepage of oil from riveted seams in corners. **5-6' standing water/oil. Leaking shell plating on bottom of tank.**

Ensure dewatered blister tankage outboard, cut away 3" piping and install 12" x 12" $\frac{3}{4}$ " A-36 mild steel doubler plate.

Dewater B-79F. Ensure dewatered blister tankage outboard and investigate for possible leakage in tank bottom; make existing plating suitable for welding approximately 30 sq. ft of $\frac{3}{4}$ " A-36 mild steel doubler plate over holed plating.



Figure 58. Standing water at turn of bilge in B-79F

3.2.2 B-29S, Frames 65 – 69

Space is mildly corroded with partially intact paint system on the upper tank and mild/moderate corrosion (15 – 20%) of shell plating and scantlings as one proceeds to tank bottom. No standing water. This space requires no structural repairs or modifications.

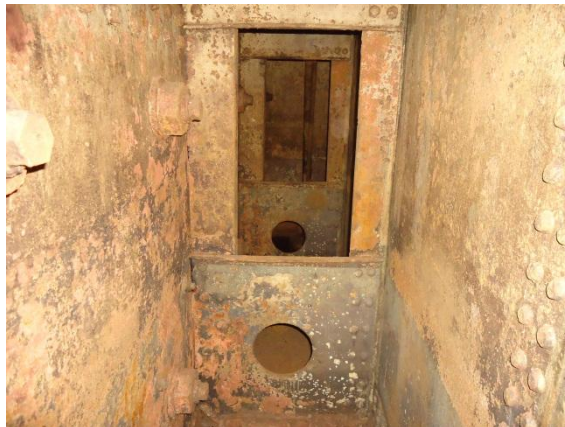


Figure 59. Interior of B-29S.

3.2.3 B-81F, Frames 65 – 69

Space is moderately corroded, but not structurally deficient. Upper tank side shell and scantling degraded 25%, floors 20 -30%. Minor seepage of oil emanating from riveted seams in upper flat. Intermediate flat exterior shell plating slightly buckled throughout space but is not considered a structural issue. Lower tank side shell and scantlings degraded 30 – 40%, floors degraded 40%. Rivets degraded 20 – 25%. Peeling paint and much rust/scale abound. Minor seepage of oil from riveted seams in corners. 2 - 3” of standing oily muck/rust in bottoms.



Figure 60. Bottom of tank in B-81F.

3.2.4 B-30S, Frames 69 – 73

Not inspected at time of survey.

3.2.5 B-83F, Frames 69 - 73

Not inspected at time of survey.

3.2.6 B-31S, Frames 73 - 78

Space is mildly corroded with partially intact paint system on the upper tank and mild/moderate corrosion (15 – 20%) of shell plating and scantlings as one proceeds to tank bottom. No standing water. This space requires no structural repairs or modifications.



Figure 61. Interior of B-31S.

3.2.7 B-85F, Frames 73 - 78

[Type text]

Space is moderately corroded, but not structurally deficient. Upper tank side shell and scantling degraded 15%, floors 20 -30%. Minor seepage of oil emanating from riveted seams in upper flat. Intermediate flat showing 15 – 20% wastage throughout. Lower tank side shell and scantlings degraded 30 – 40%, floors degraded 40%. Rivets degraded 20 – 25%. Peeling paint and much rust/scale abound. Minor seepage of oil from riveted seams in corners. 2 - 3" of standing oily muck/rust in bottoms. Intermediate flat has two (2) 3" pipes through side shell plating.

Ensure dewatered blister tankage outboard, cut away two (2) 3" piping and install 12" x 12" $\frac{3}{4}$ " A-36 mild steel doubler plate over each pipe cut-out.



Figure 62. Piping into blister tankage through side shell plating in B-85F.

3.2.8 C-44S, Frames 76 - 84

Space is mildly corroded with partially intact paint system on the upper tank and mild/moderate corrosion (15 – 20%) of shell plating and scantlings as one proceeds to tank bottom. Minor oil seepage from riveted seams. No standing water. This space requires no structural repairs or modifications.



Figure 63. Interior of C-44S.

3.2.9 C-81F, Frames 78 – 84

Space is mild/moderately corroded, but not structurally deficient. Upper tank side shell and scantling degraded 10%, floors 20 -30%. Intermediate flat showing 15 – 20% wastage throughout. Lower tank side shell and scantlings degraded 20%, floors degraded 30%. Rivets degraded 20 – 25%. Peeling paint and much rust/scale abound. Minor seepage of oil from riveted seams in corners on intermediate and bottom flats. 2 - 3” of black oil and standing oily muck/rust in bottoms



Figure 64. Black oil resting on tank bottom in C-81F.

3.3.0 C-45S, Frames 84 -89

Space is mildly corroded with partially intact paint system on the upper tank and mild/moderate corrosion (15 – 20%) of shell plating and scantlings as one proceeds to tank bottom. No standing water. This space requires no structural repairs or modifications.

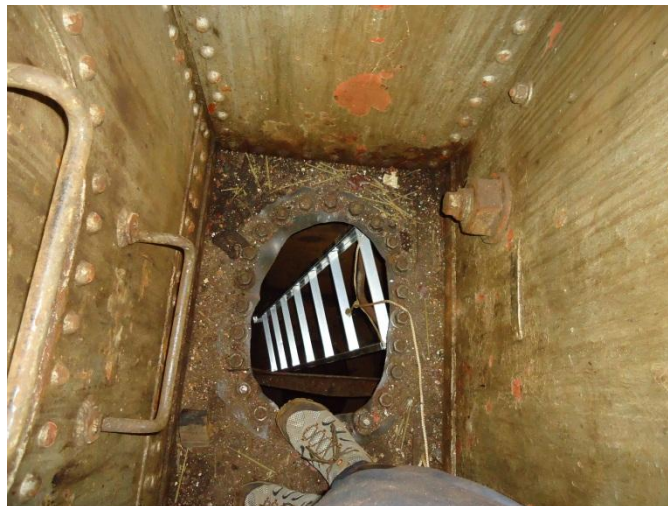


Figure 65. Looking at floor on C-45S.

3.3.1 C-83F, Frames 84 - 89

[Type text]

Space is mild/moderately corroded, but not structurally deficient. Upper tank side shell and scantling degraded 10%, floors 20 -30%. Two (2) 3" pipes passing through shell plating into blister tankage. Intermediate flat showing 15 – 25% wastage throughout with oil seepage from riveted seams. Lower tank side shell and scantlings degraded 30%; one (1) 6" pipe passing through shell plating into blister tank. Rivets degraded 20 – 25%. Peeling paint and much rust/scale abound. Minor seepage of oil from riveted seams in corners on intermediate and bottom flats. 2 - 3" of standing black oil and standing oily muck/rust in bottoms

Ensure dewatered blister tankage outboard, cut away two (2) 3" piping and install 12" x 12" $\frac{3}{4}$ " A-36 mild steel doubler plate over each pipe cut-out on upper flat.

Ensure dewatered blister tankage outboard, cut away one (1) 6" piping and install 12" x 12" $\frac{3}{4}$ " A-36 mild steel doubler plate over each pipe cut-out on lower flat.



Figure 66. Through-hull piping into blister tank in C-83F.



Figure 67. Through-hull piping into blister tank in C-83F.

3.3.2 C-46S, Frames 89 – 94

Space is mildly corroded with partially intact paint system on the upper tank and mild/moderate corrosion (15 – 20%) of shell plating and scantlings as one proceeds to tank bottom. No standing water. This space requires no structural repairs or modifications.



Figure 68. Interior of tank C-46S.

3.3.3 C-85F, Frame 89 – 94

Space is mild/moderately corroded, but not structurally deficient. Upper tank side shell and scantling degraded 10%, floors 20 -30%. Intermediate flat showing 15 – 20% wastage throughout. Lower tank side shell and scantlings degraded 20%, floors degraded 30%. Rivets degraded 20 – 25%. Peeling paint and much rust/scale abound. Minor seepage of oil from riveted seams in corners on intermediate and bottom flats. 1 - 3" of standing water and rust in bottoms



Figure 69. Bottom of tank in C-85F.

3.3.4 C-47S, Frames 94 – 99

[Type text]

Space is mildly corroded with partially intact paint system on the upper tank and mild/moderate corrosion (15 – 20%) of shell plating and scantlings as one proceeds to tank bottom. No standing water. This space requires no structural repairs or modifications.



Figure 70. Interior of C-47S.

3.3.5 C-87F, Frames 94 – 99

Space is mild/moderately corroded, but not structurally deficient. Upper tank side shell and scantling degraded 10%, floors 30 -40%. One (1) 2" pipe through to blister tank. Intermediate flat showing 15 – 20% wastage throughout. Lower tank side shell and scantlings degraded 20%, floors degraded 30%. Rivets degraded 20 – 30%. Peeling paint and much rust/scale abound. Minor seepage of oil from riveted seams in corners on intermediate and bottom flats. 1 - 3" of standing water and rust in bottoms Two (2) 3" pipes are in the upper flat and one (1) 6" pipe is in the lower flat through the shell plating into the blister.

Ensure dewatered blister tankage outboard, cut away two (2) 3" piping and install 12" x 12" $\frac{3}{4}$ " A-36 mild steel doubler plate over each pipe cut-out on upper flat.

Ensure dewatered blister tankage outboard, cut away one (1) 6" piping and install 12" x 12" $\frac{3}{4}$ " A-36 mild steel doubler plate over each pipe cut-out on lower flat.

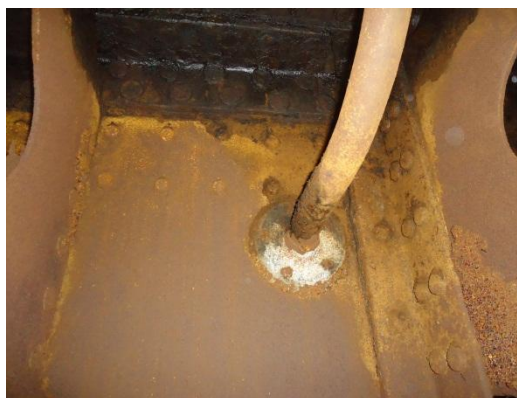


Figure 71. 2" pipe into blister tank from C-87F

3.3.6 C-48S, Frames 99 – 104

Space is mildly corroded with partially intact paint system on the upper tank and mild/moderate corrosion (15 – 20%) of shell plating and scantlings as one proceeds to tank bottom. No standing water. This space requires no structural repairs or modifications.



Figure 72. Interior of C-48S.

3.3.7 C-89F, Frames 99 - 104

Space is mild/moderately corroded, but not structurally deficient. Upper tank side shell and scantling degraded 10%, floors 30 -40%. Intermediate flat showing 15 – 20% wastage throughout. Lower tank side shell and scantlings degraded 20%, floors degraded 30%. Rivets degraded 20 – 30%. Peeling paint and much rust/scale abound. Minor seepage of oil from riveted seams in corners on intermediate and bottom flats. 1 - 3" of standing water and rust in bottoms. The lower flat has two (2) 6" pipes and one (1) 8" pipe through the side shell plating to the blister tank.

Ensure dewatered blister tankage outboard, cut away two (2) 6" piping and install 14" x 14" $\frac{3}{4}$ " A-36 mild steel doubler plate over each pipe cut-out on lower flat.

Ensure dewatered blister tankage outboard, cut away one (1) 8" piping and install 16" x 16" $\frac{3}{4}$ " A-36 mild steel doubler plate over each pipe cut-out on lower flat.



Figure 73. Interior of tank C-89F.

3.3.8 D-39S, Frames 104 -110

[Type text]

Space is mildly corroded with partially intact paint system on the upper tank and mild/moderate corrosion (15 – 20%) of shell plating and scantlings as one proceeds to tank bottom. No standing water. This space requires no structural repairs or modifications. **Upper ladder rung broken.**



Figure 74. Lower forward portion of D-39S.

3.39 D-91F, Frames 104 – 110

Space is mild/moderately corroded, but not structurally deficient. Upper tank side shell and scantling degraded 5 - 10%, floors 30 -40% degradation in lower flat. Rivets degraded 10 – 15%. Peeling paint and some rust/scale in bilges. Much seepage of oil from riveted seams in corners on intermediate and bottom flats. 1 - 3" of standing water/oil and rust in bottoms. Recent flooding noted, patched shell plating.



Figure 75. Intermediate flat in D-91F showing effects of oil seepage.

Ensure adjacent blister tankage is dry. Properly prepare shell plating and install estimated 400 square feet of 3/4" A-36 mild steel doubler plating.

3.40 D-40S, Frames 110 – 116

Space is mildly corroded with partially intact paint system on the upper tank and mild/moderate corrosion (15 – 20%) of shell plating and scantlings as one proceeds to tank bottom. 6” – 1’ of standing water in bilges.. This space requires no structural repairs or modifications.



Figure 76. Bottom of tank showing standing water in D-40S.

3.4.1 D-93F, Frames 110 - 116

Space is mild/moderately corroded, but not structurally deficient. Upper tank side shell and scantling degraded 5 - 10%, floors 30 -40% degradation in lower flat. Rivets degraded 10 – 15%. Peeling paint and some rust/scale in bilges.. Much seepage of oil from riveted seams in corners on intermediate and bottom flats. 1 - 3” of standing water and rust in bottoms. Recent flooding noted, patched shell plating.



Figure 77. Turn of bilge frames and shell plating in D-93F.

3.4.2 D-41S, Frames 116 – 122

[Type text]

Space is moderately corroded with partially intact paint system on the upper tank and mild/moderate corrosion (30 – 40%) of shell plating and scantlings as one proceeds to tank bottom. 1' of standing water in bilges. A 2" pipe extends through shell plating to outside fuel tank; not an issue at this time.



Figure 78. Bottom of tank showing standing water in D-41S.

3.4.3 D-93V. Frames 116 – 122

Space is badly corroded and structurally deficient. Upper tank side shell and scantling degraded 30- 40%, floors 30 -40%, degradation in lower flat 40 – 80%. Rivets degraded 30 – 40%. Peeling paint and much rust/scale in bilges. Large area of shell plating 8' x 32' badly wasted. Hole shell plating to exterior blister tankage. Much seepage of oil from riveted seams in corners on intermediate and bottom flats. 1 - 3" of standing water and rust in bottoms. Recent flooding noted, patched shell plating.

Ensure dewatered blister tankage outboard, install 3' x 3' 3/4" A-36 mild steel doubler plate over holed shell plating on lower flat.

Ensure dewatered blister tankage outboard, properly prepare surface, install 330 square feet of 3/4" A-36 mild steel doubler plate over wasted shell plating on lower flat.



Figure 79. Wasted shell plating on lower exterior in tank D-93V.

3.4.4. Naval Architect's Comment on Repairs to Port Tankage

3.4.4.1. The shell plating represents the main line of defense of the battleship against water intrusion. Returning the plating to its original watertight condition and elimination of all piping penetrations between the blister tankage and the original shell are considered the primary repairs at this time.

3.4.4.2. Repair of the plating by doubler plates rather than the more cosmetic "cut and replace" are believed to ensure that the repairs are as watertight as possible. Likewise removal of pipe penetrations and reinforcement with a doubler plate will minimize the chances of any liquids in the blister tanks finding a way into the main hull of the battleship.

3.4.4.3. Restoration of the watertight integrity of the main hull plating, along with a maintenance plan to ensure the paint and cathodic protection remain effective, will significantly extend the useful life of the hull of the battleship.

4. SUMMARY

This report attempts to put repairs that are required for the Option 6 proposal into perspective with regard to sequencing of repairs, materials required and estimated costs for this progression.

The costs for the tasking described within the body of this report is attached within the Appendix.

The repairs that have been described are not the total of work that needs to be accomplished under Option 6, but represents approximately an 80% threshold of repairs estimated needed to carry out this progression. Blister tank inspections were not carried out and there remains questions about the viability of keeping the hull watertight during the floating process.

However, given the extensive threshold of repairs to be carried out under the combined Scenarios of Option 5 & Option 6, U.S.S. TEXAS will be given a period of several years at her existing berth.

Repairs have been kept to the absolute minimum, but are thorough where structural rigidity is needed.

Respectfully submitted,



Joseph Lombardi
Marine Surveyor



Jerry Possehl
Naval Architect

5. APPENDIX

[Type text]

SUMMARY OF TASKING OPTION 6

Shell plate repair port side:	3,118 sq. ft. ¾" A-36 mild steel plating	
Shell plate repair starboard side:	1,460 sq. ft. ¾" A-36 mild steel plating	
Total square footage:	4,578 ¾" A-36 mild steel plate @ \$ 950.00/sq. ft.	\$ 4,349,100.00
Paint	4,578 sq. ft @ \$ 22.00/sq. ft.	100,716.00
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Total Option 6 Cost		\$ 4,449,816.00
Total Option 5 Cost (Subtotal before Profit and Overhead)**		\$ 16,923,194.00
Total Option 6 Cost		4,449,816.00
General Conditions		575,000.00
Contractor mob/demob with 40' x 110' spud barge, 100 ton crane, 35 ton crane, pusher tug, two 200 kw generators, one flatbed trailer, one Hyster fork truck, six welding machines, six oxy/acetylene units, one contractor trailer, power, phones, two Porti-Pottis		450,000.00
General Liability Insurance		65,000.00
Builder's Risk Insurance		47,500.00
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Total		\$ 22,510,510.00
Bonds (2%)		440,210.20
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Total		\$ 22,950,720.20
Profit & Overhead 15%		3,442,608.03
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Total		\$ 26,393,328.23
Contingency 15%		3,958,999.23
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Total Cost of Option 5 & Option 6 Tasking		\$ 30,352,327.46

**Option 5 cost from "USS Texas (BB-35) Option 5 Tank Inspection and Repair Assessment" by Joseph Lombardi, Ocean Technical Services, LLC. Survey date January 2012